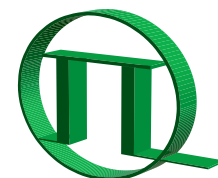
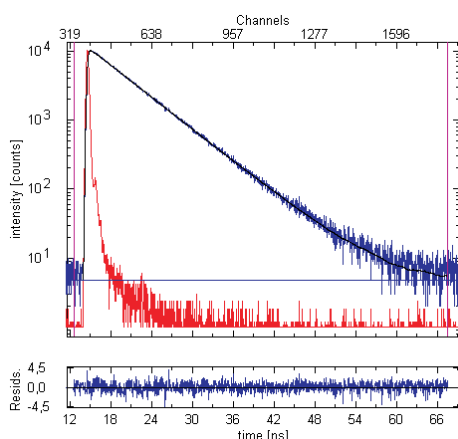


# FluoTime 100



PICOQUANT

## Compact Fluorescence Lifetime Spectrometer



- Compact plug-and-measure design
- Based on Time-Correlated Single Photon Counting (TCSPC)
- Easy-to-use picosecond diode laser or sub-nanosecond LED light source
- Data acquisition in shortest time
- Filters for high optical throughput
- Advanced data analysis



## Applications

- Time-resolved fluorescence spectroscopy and anisotropy
- Ultra sensitive analysis
- Photochemistry
- Marker and assay development
- Ideal for research and teaching purpose

## Configuration and Standard Components

The FluoTime 100 is an easy to use, ultra compact time-resolved fluorescence spectrometer. It includes the complete optics and electronics for recording fluorescence decays via Time-Correlated Single Photon Counting (TCSPC). The system can be used with either picosecond diode lasers (LDH Series) or sub-nanosecond pulsed LEDs (PLS Series). With the FluoTime 100, decay times as low as 40 picoseconds can be resolved. The system allows operation at laser repetition rates as high as 85 MHz and count rates up to several million counts/sec.



### Laser coupling module

The laser coupling module consists of a holder for uncooled laser/ LED heads interlocked with the detector. The holder locks the orientation of the laser head to emit either vertically or horizontally polarized radiation. The beam is directed towards the sample by an adjustable steering mirror. A mounting plate for a cooled LDH Series head or a mirror holder is additionally available..

### Sample chamber

The sample chamber contains a versatile sample holder for cuvettes. The tubing for a circulating fluid is pre-installed. A front face sample holder and a fiber probe are available as an option. Holders for filters, sheet polarizers and lenses in excitation and emission are positioned inside the sample chamber. For security, the sample chamber lid is interlocked with the detector.

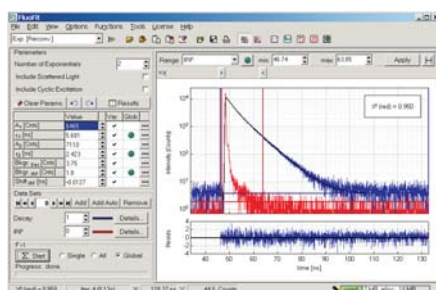


### Filter wheels

Two filter wheels are the components of the spectrometer, one for regulating the intensity of the excitation light, the other for filtering scattered excitation light and for selecting the spectral range of interest for detection. The standard excitation filter holder contains filters of 50 %, 10 %, 1 % and 0.1 % transmission. The emission filter wheel holds various cut-off and/or bandpass filters depending on the customer's request.

### Data analysis

Numerical analysis of the raw data is an integral part of the TCSPC method. FluoFit is an Windows™ based decay analysis software with an easy-to-use graphical user interface and presentation-ready numerical and graphical output. It implements an iterative reconvolution fitting routine with nonlinear error minimization.



Various exponential decay models (up to fourth order) or rate constant distribution models can be fitted to the observed decay. FluoFit also supports the analysis of anisotropy measurements as well as global analysis for all methods. Running FluoFit simultaneously with the measurement software allows for parallel data analysis.

### TCSPC data acquisition

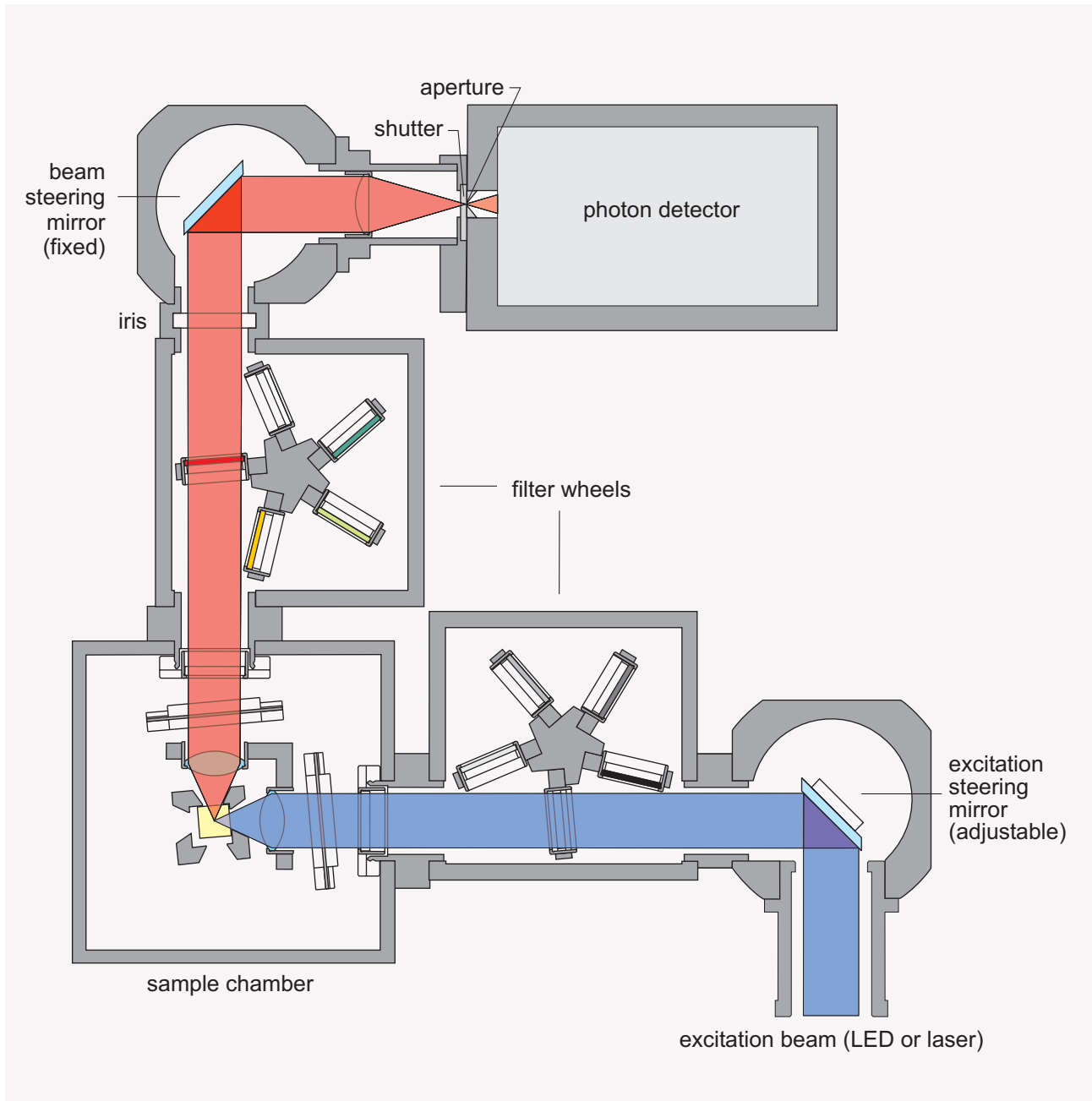
The data acquisition module (PicoHarp 300) contains the complete timing electronics for Time-Correlated Single Photon Counting (TCSPC). More than 1 million counts per second can be processed. Consequently, TCSPC acquisition times shorter than 1 second can be utilized. All functions of the TCSPC modules are controlled by easy-to-use Windows™ based software. These functions include loading and saving experimental data, as well as setting and storing measurement parameters. For investigation of long lifetime samples, the NanoHarp 250 photon counter/multiscaler is available as an option.

### Detector

The PMA detector unit, based on the Hamamatsu H5783 series photosensor module, is recommended for the majority of applications. The unit has a built-in high voltage power supply, signal pre-amplifier and a gold plated iron housing for optimal timing performance and maximum RF and magnetic shielding. With this detector unit, an Instrument Response Function (IRF) as short as 200 ps, in combination with the PicoHarp 300 and a diode laser, can be achieved. Various different cathode types are available to cover the spectral range between 185 and 850 nm.



## Optical Layout





## Options and Accessories

### Sheet polarizers

For fluorescence anisotropy measurements 20 mm aperture sheet polarizers are supplied with the instrument. Optional UV optimized polarizers are available.

### Front face sample holder

An adjustable front face sample holder can replace the standard cuvette holder. It allows front surface excitation and detection of the luminescence response with minimum scattered and reflected excitation light.

### Fiber probe

The FluTime 100 can optionally be equipped with a fiber probe for excitation and emission collection. For this purpose the usual sample chamber is modified to hold the fiber probe. This special configuration gives even more freedom and flexibility to investigate different kinds of samples.

### Water-cooled sample holder

The standard sample holder accommodates 1 cm (or smaller) path length cuvettes. Temperature control of the sample is possible by circulating liquid (the tubing is pre-installed). An external thermostat (optional) can be attached. The cuvette holder can be optionally equipped with a magnetic stirrer.

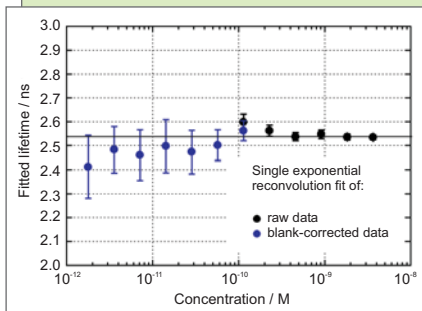
### Filters

Under certain circumstances, the pre-installed filter set may not be sufficient for the given excitation source and fluorescent sample combination. Additional filters can be inserted into both excitation and emission arms, using the tilted filter holders in the sample chamber.

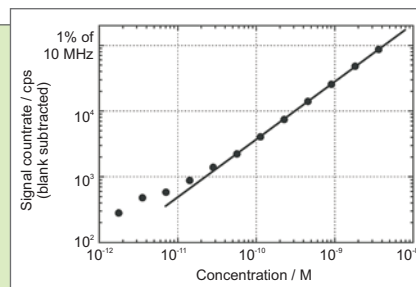
### Cooled photomultiplier tube

Instead of the PMA detector assembly, the FluTime 100 can be equipped with a Peltier-cooled Photomultiplier Tube (PMT), e.g. the H7422 detector module from Hamamatsu. Cooling the PMT considerably decreases its thermal noise, i.e. suppresses the so-called "dark counts". The smaller dark count rate means better signal-to-noise (S/N) ratio, and the result is an ultimate sensitivity.

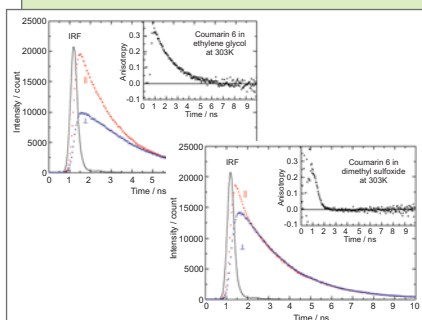
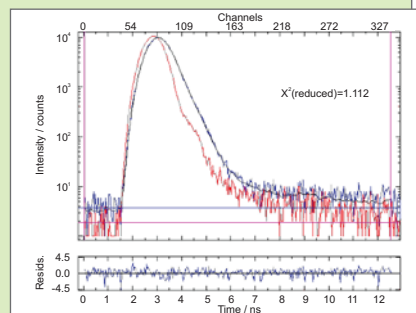
## Measurement Examples



To demonstrate the sensitivity of the FluTime 100, a set of very diluted solutions of Coumarin 6 in Ethanol was measured. The samples were excited at 10 MHz repetition rate with the LDH-P-C-405 diode laser. The average excitation intensity in the sample volume was 80  $\mu\text{W}$ . Magic angle polarized fluorescence was collected through a 530 nm longpass filter. The detected intensity decreases linearly with the concentration down to 50 pM. Below this concentration, the weak, parasitic fluorescence of the glass filter must be taken into account. Performing a blank measurement with the pure solvent as a sample and subtracting this blank measurement from the TCSPC histograms allowed a single exponential lifetime analysis at picomolar concentrations.



The example on the right shows a time-resolved fluorescence measurement of Exciton LDS750 dye ( $10^{-7}$  molar in Ethanol). The sample was excited at 20 MHz repetition rate with a PLS 600 pulsed LED diode, which has a pulse width of 940 ps (FWHM). The emission was detected by the PMA 185 detector. The plot shows the measured Instrument Response Function (red), the sample decay (blue) and the fitted decay (black). The fitted fluorescence lifetime is  $310 \pm 10$  ps.



The example on the left shows a time-resolved anisotropy measurement of Coumarin 6 in ethylene glycol (EtGly) and dimethyl sulfoxide (DMSO) solvents at a temperature of 303 K. The sample was excited with the LDH-P-C-405 diode laser and the emission was detected with the PMA 182 detector. The FluTime 100 was equipped with sheet polarizers. The figures show the recorded polarized decays, the IRF of the measurement and the calculated fluorescence anisotropy decay. Fitting the anisotropy decay to a single exponential model without reconvolution yields 1.9 ns and 270 ps rotational correlation time of Coumarin 6 in EtGly and DMSO, respectively. The results reflect the different viscosity of the solvents.

# Specifications

## System

Optical configuration . . . . . L-Geometry  
 Mode of operation . . . . . Time-Correlated Single Photon Counting (TCSPC)

## Excitation Sources

Light source . . . . . pulsed LEDs (PLS Series) . . . . . laser diode heads (LDH Series)  
 Wavelengths . . . . . 255 - 600 nm . . . . . 375 - 510, 530, 635 - 1550 nm  
 Pulse width . . . . . 400 ps - 1 ns . . . . . 60 - 500 ps  
 Repetition rate . . . . . up to 40 MHz . . . . . up to 40 MHz (optional 80 MHz)

## Detectors

Type<sup>1)</sup> . . . . . PMT (PMA Series)  
 Spectral range . . . . . 185 - 650 nm . . . . . 185 - 820 nm  
 Dark counts (at 20°C, typ. value) . . . . . < 50 cps . . . . . < 900 cps

## Data Acquisition Unit

Type . . . . . NanoHarp 250 . . . . . PicoHarp 300  
 Time resolution (bin width) . . . . . 4 ns, 32 ns . . . . . 4 ps  
 Count depth . . . . . 18 bit . . . . . 16 bit  
 Dead time . . . . . 8 ns . . . . . < 95 ns  
 Lifetime resolution . . . . . < 10 ns . . . . . < 30 ps  
 Time channels per curve . . . . . 1024 to 262144 . . . . . 65536  
 Differential non-linearity . . . . . < 0.1 % rms, < 1 % pp . . . . . < 1 % rms, < 5 % pp.  
 Discriminator level, zero cross adjust . . . . . software adjustable  
 Collection time . . . . . 1 ms - 10 h

## Data Analysis Software

Type . . . . . FluoFit (FluoFit Basic, FluoFit Professional)  
 Analysis possibilities . . . . . exponential decay, lifetime distribution, anisotropy, global analysis for all methods

## Operation

Operating system . . . . . Windows™ 2000, XP, Vista, 7

## Electrical & Dimensional

Power requirements . . . . . 220/240 or 110/120 VAC, 50/60 Hz  
 Dimensions . . . . . 300 × 200 × 100 mm (w × d × h)

*1) other detectors and cooling available upon request*

## Other PicoQuant Systems

**FluoTime 200**  
 High performance  
 fluorescence lifetime  
 system



**FluoTime 300 "EasyTau"**  
 Automated Fluorescence  
 Lifetime Spectrometer



**LSM Upgrade Kit**  
 Compact lifetime and FCS upgrade  
 kit for Laser Scanning Microscopes



**MicroTime 200**  
 Inverse time-resolved  
 fluorescence  
 microscope



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